SAND2021-1547C

SANDIA'S 3rd ANNUAL XR CONFERENCE

AUGMENTED, VIRTUAL, AND MIXED REALITY

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BUILDING A VR MOTION SIMULATOR - INTRO AND CALL FOR PARTICIPATION

PRESENTED BY

JAN CIESKO

1465, SCALABLE ALGORITHMS, COMPUTER SCIENCES

AGENDA

- My story
- Some insights
- First prototype and what's next
- Community engagement
- Call for Participation

MY STORY

- Postdoc in 1465, Scalable Algorithms
- Working on parallel programming models
- Advocate for virtual motorsports (in conclusion)

FIRST CHASSIS (2017)

- VR was reaching early adopters (Oculus DK2)
- Stationary experiences
- Man-in-the-loop simulation is *the* use-case for VR

Simulator prototype to explore dimensions, seat mount-points, seating angles, requirements on adjustability and price

EARLY INITIATIVES (~2017)

Virtual Race Club - Sim Racing Barcelona

User and research group

Interested in:

- Car racing (but not enough money for race car?)
- Sim racing (iRacing, Assetto Corsa, rFactor)
- Physics engine research
- Electronics and actuator control
- Building a cockpit based on Open Simwheel (OSW)

Join here:

- Facebook: VRCSimRacingBarcelona

Numerical Monkeys

Sim Racing Club Barcelona - a student research initiative for advancement and popularization of simulated car driving and racing

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Universidad Politécnica d
January, 2018

Sim Racing Club Barcelona (SRCB) is a *student researcl*
of Catalonia (UPC). The overall interest of the rese
software and hardware development, exploration of
broader community of faculty and students.

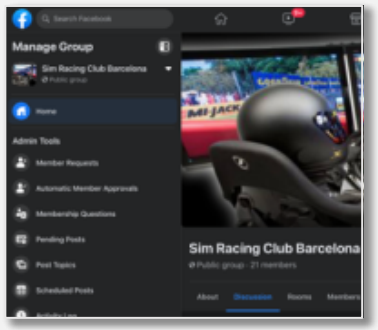
In particular, SRCB is interested in the following tech
simulation hardware including materials (laminatio
simulation software engines, open-source hardware (
simulation and tire simulation models. Beyond rese
project intends to reduce car and motorcycle street ra

SRCB's main goals are:

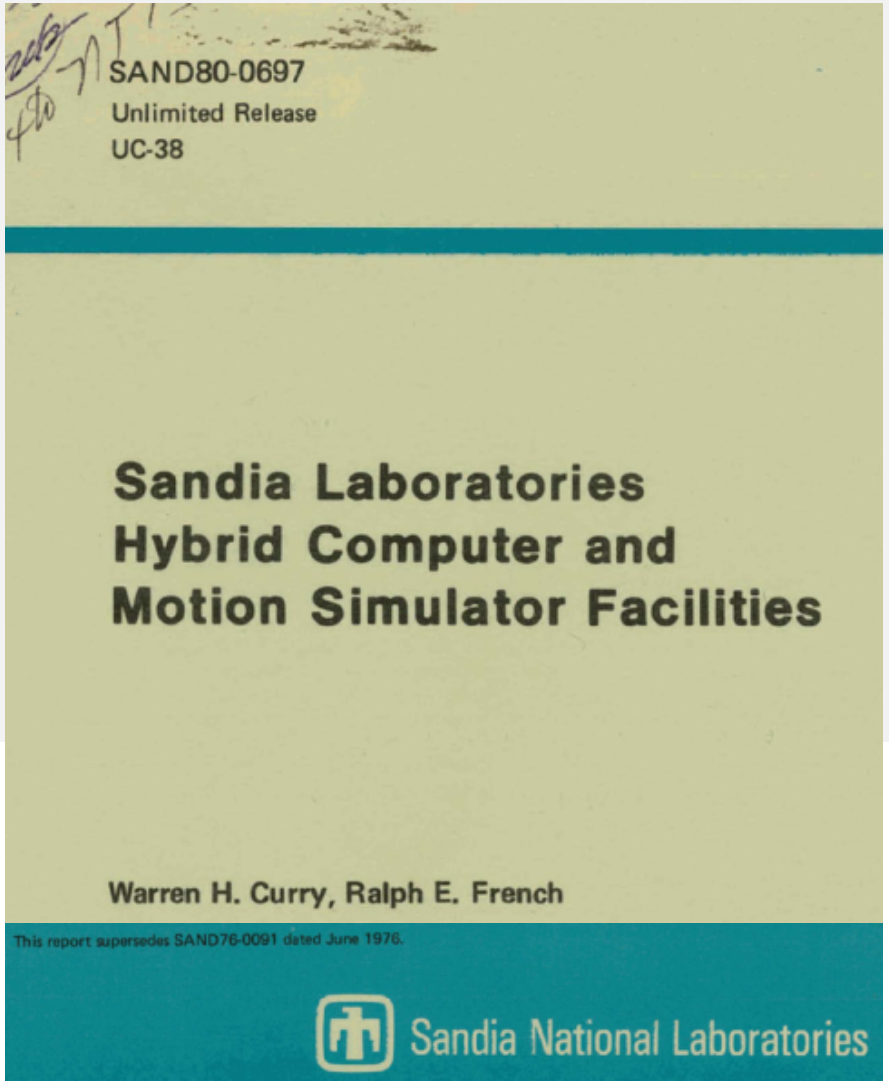
1. Contribute to open-source software, existing projects[1], documentation and understanding of existing mathematical models and algorithms, and develop new algorithms in areas of rigid-body simulation and tire models[23].
2. Contribute to DIY maker space by providing new reference implementations for cost-efficient motion simulators. This includes frame, actuators and controllers.
3. Install one motion simulator at the campus of the UPC by early 2019.
4. Explore usability of Virtual Reality.
5. Contribute to road safety by supporting the initiative of virtual racing.

Research	- Physics engines - Rigid-body dynamics models and codes - Tire models - Performancde optimization	- Material design - Robotics (servos, hydraulics, actuators) - Bass shakers - Controllers	- Behavior studies - Virtual Reality in practice	
Impact	- Open-source sim racing software	- DIY components, cost effeciency		- Take racing off the streats
Domain	Informatics	Engineering	Sociology	Society

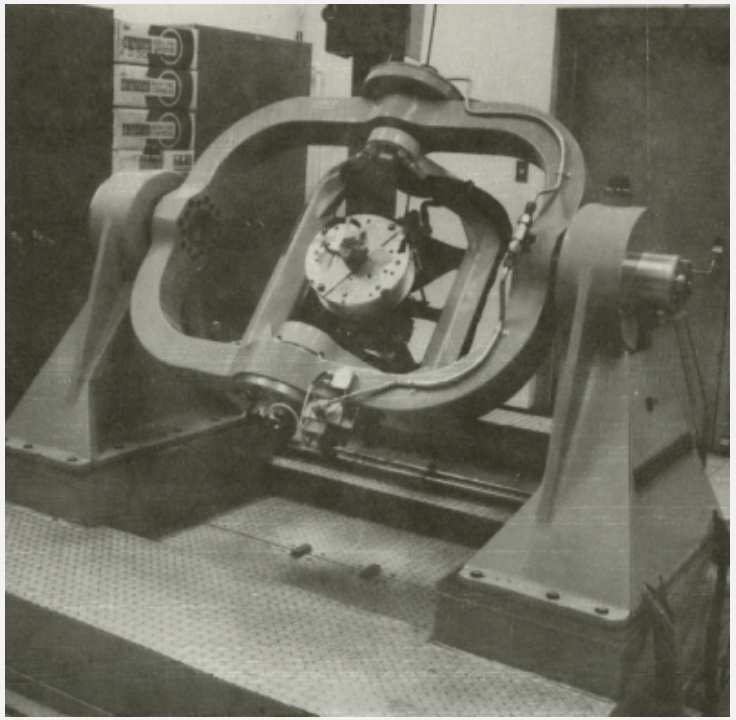
Figure 1: Project scope showing four areas of engagement with the primary goal to contribute to open-source software, DIY maker space, social sciences as well as to reduce street racing related accidents



@ SNL: INERTIAL NAVIGATION TEST EQUIPMENT (1976)



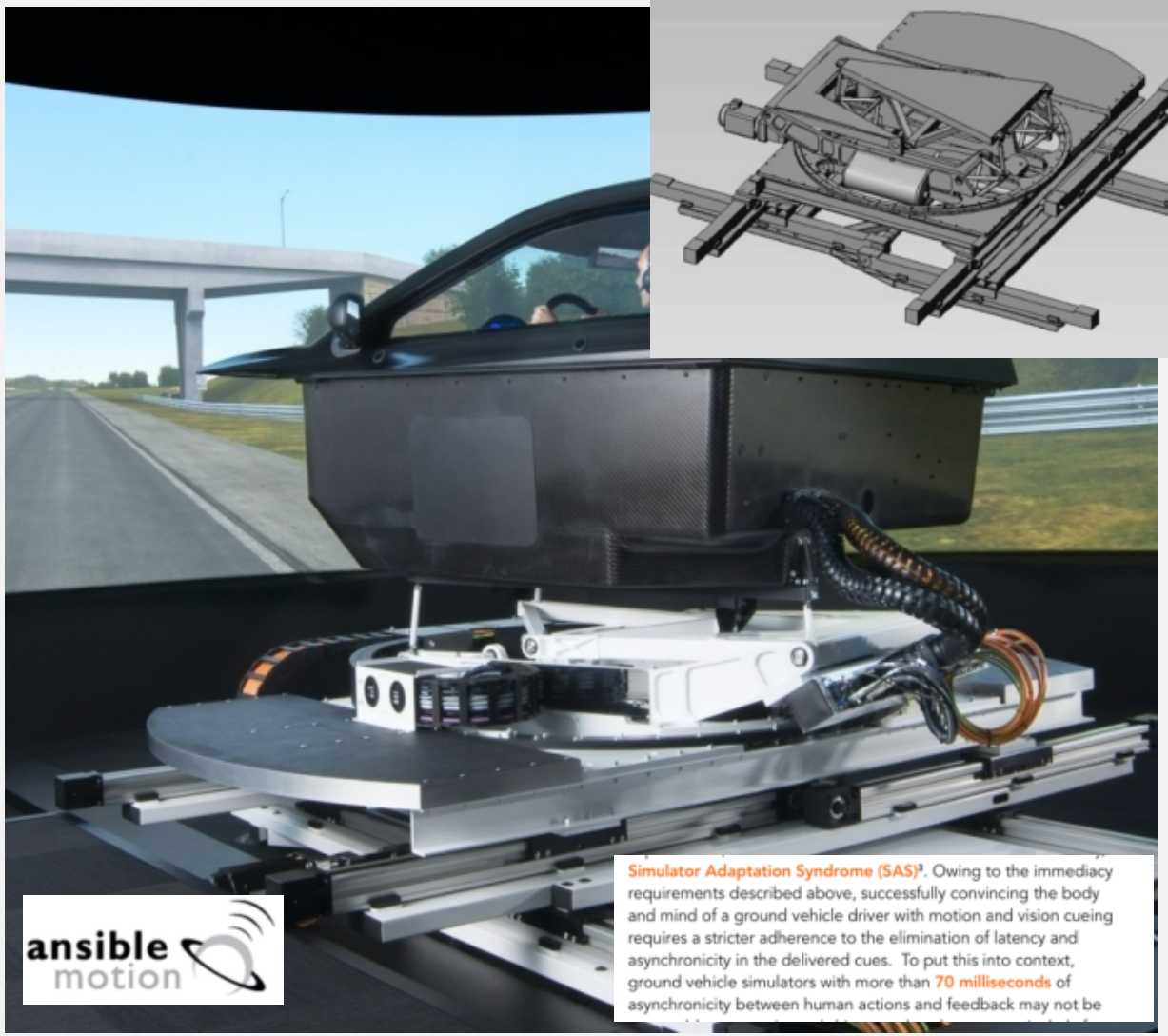
https://www.osti.gov/biblio/5256501/



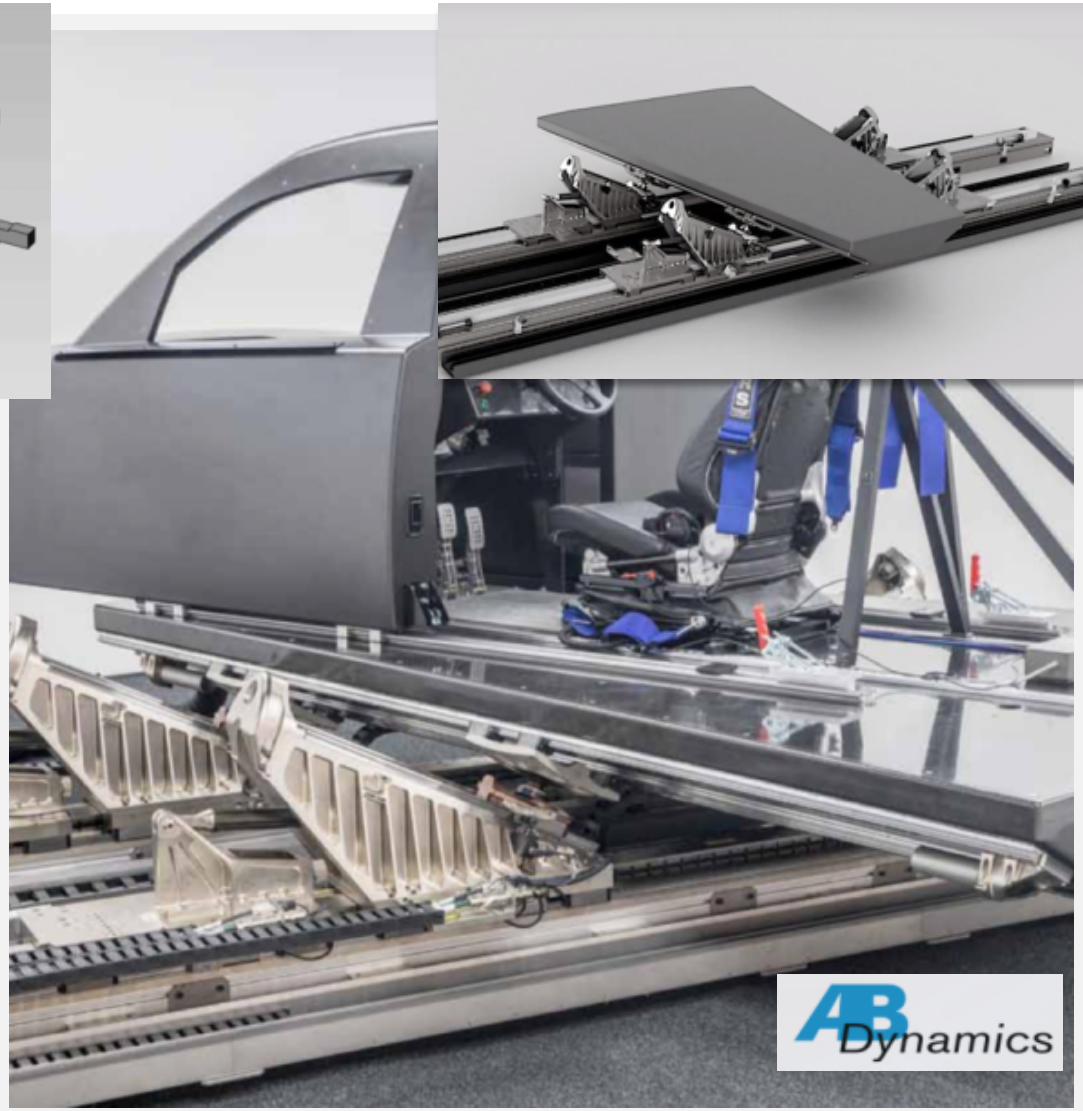
Carco S-450-3

Hybrid computer and motion simulator facilities at Sandia National Laboratories are located in both Albuquerque and Livermore. The Albuquerque equipment complement includes two AD/FIVE analog computers interfaced to a PDP11/60 digital computer, an AD10 digital multiprocessor, and a Carco S-450R-3/R-493A three-axis motion simulator. Another two AD/FIVE analog computers are interfaced to a PDP11/45 digital computer. An EAI580 analog computer, together with a TR48 analog computer, is interfaced to a Nova 800 digital computer. An EAI680 analog computer is used in the analog mode only. Livermore equipment includes an EAI7800

DRIVER IN MOTION (1/2)



Simulator Adaptation Syndrome (SAS)[3]. Owing to the immediacy requirements described above, successfully convincing the body and mind of a ground vehicle driver with motion and vision cueing requires a stricter adherence to the elimination of latency and asynchronicity in the delerived cues. To put this into context, ground vehicle simulators with more than 70 milliseconds of asynchronicity between human actions and feedback may not be



http://ansiblemotion.com/
https://www.abdynamics.com

DRIVER IN MOTION (2/2)

https://www.cruden.com/automotive-driving-simulators/

CONVERGENCE

Research

The National Advanced Driving Simulator
The University of Iowa

- Papers
  - The Future of Roadway Safety
  - Measuring the useful field of view during simulated driving with gaze-contingent displays
  - Creating Pedestrian Crash Scenarios in a Driving Simulator Environment
  - Older Drivers Acceptance of In-vehicle Systems and the Effect it has on Safety
  - Ameliorating the distracting effects of cell phone driving
  - Are gamers better crossers? An examination of action video game experience and dual task effects in a simulated street crossing task
  - Prevalence and Distribution of Young Driver Distraction Errors in Naturalistic Driving
  - Age vs. Experience: Evaluation of a Video Feedback Intervention for Newly Licensed Teen Drivers
  - Do athletes excel at everyday tasks?

https://www.nads-sc.uiowa.edu/publications.php

Automotive Engineering

- Reduce development time
  - Virtual test driving
  - Car parameter tuning
  - Noise, voice and harshness analysis
  - Subjective perception analysis

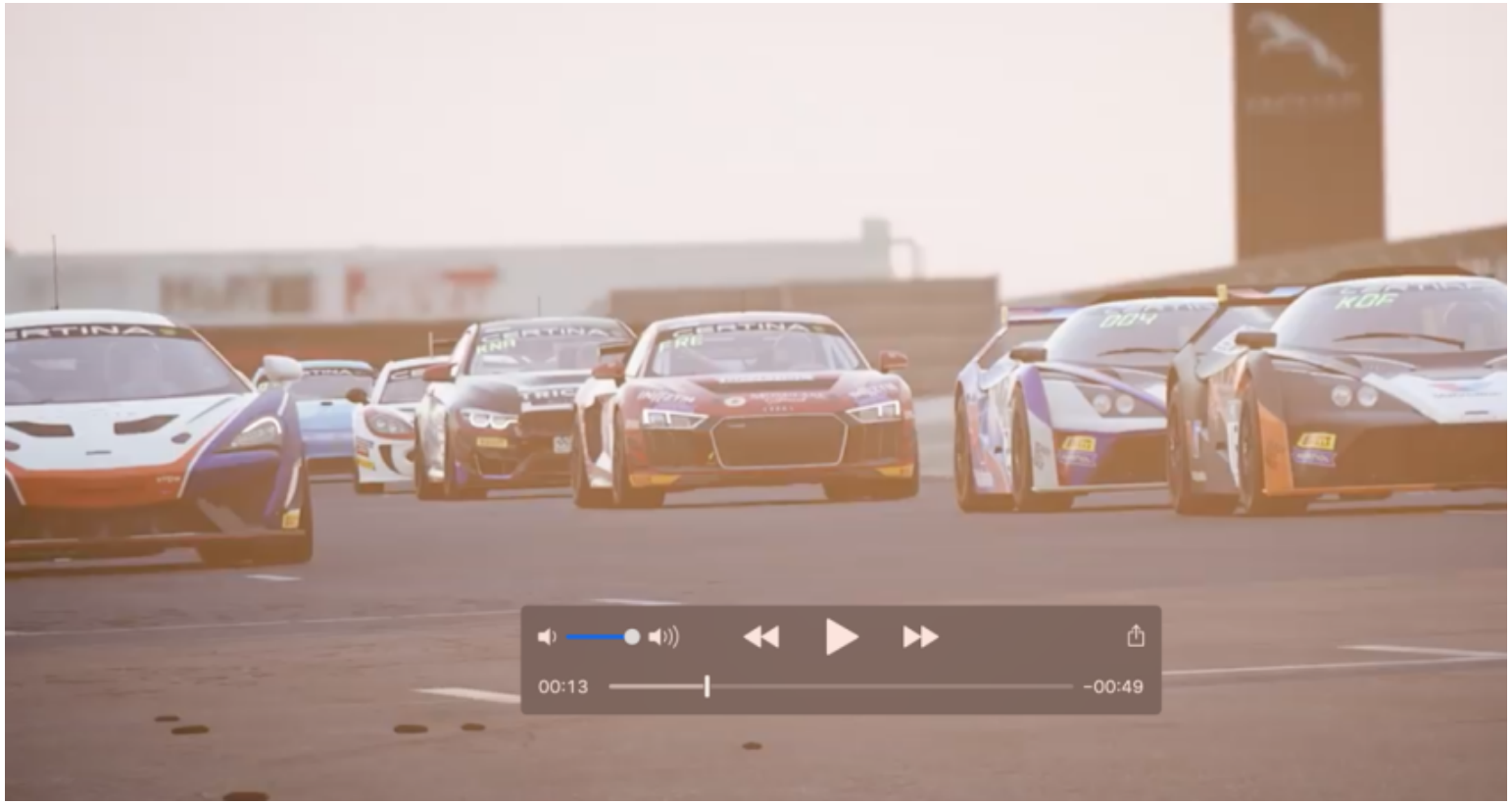
SIM PACK
dSPACE
MATLAB SIMULINK
Dymola
VIRES Simulationstechnologie GmbH
concurrent REAL-TIME
MapleSim
CarSim Mechanical Simulation
IPG
VI-CarRealTime
MODELICA
TESIS DYNAware

Entertainment

- This is a 1.4 billion dollar market
  - Official virtual series, F1, NASCAR FIA GT, V8 Supercars, GT ADAC, Porsche Esports Carrera Cup
  - 1.5 million $ in prize money
  - Every major car brand has a serious e-Team (Max Verstappen for Red Bull F1 etc.)
  - 24% growth to 2027

rFpro
IMAGE SPACE INCORPORATED
FIA MOTORSPORT GAMES 2019
KUNOS SIMULAZIONI
nKPro
@Source Podium Technology
ASSETTO CORSA COMPETIZIONE
THE OFFICIAL GT WORLD CHALLENGE GAME
iRacing.com MOTORSPORT SIMULATIONS

LIVE VIDEO: ACC



FOR DREAMERS

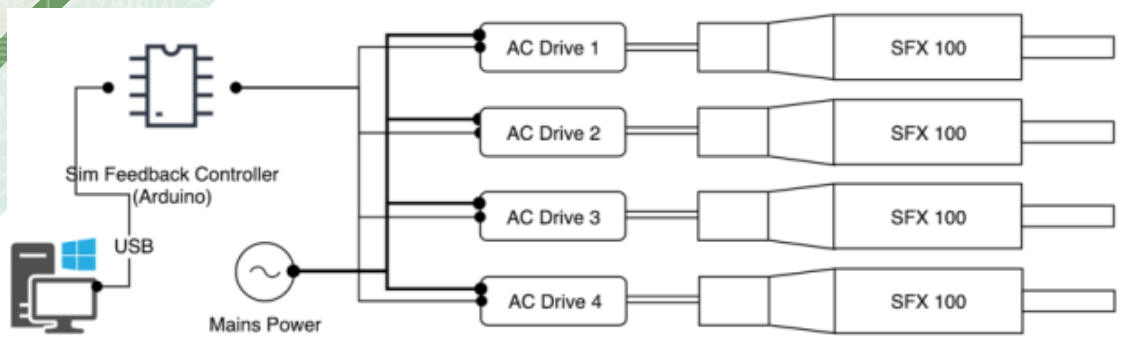
POPULAR MAINSTREAM CHASSIS

- Motum Simulation,Australia
- Vesaro, UK
- SimLab, NL

- NextLevelRacing, Australia
- MonsterTechUSA, USA

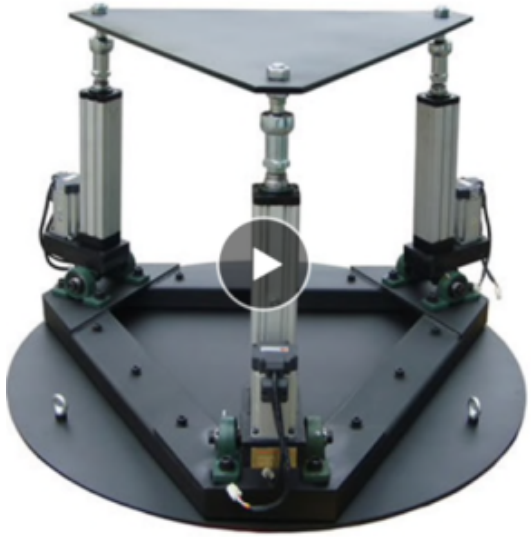
BUILDING A MOTION SIMULATOR

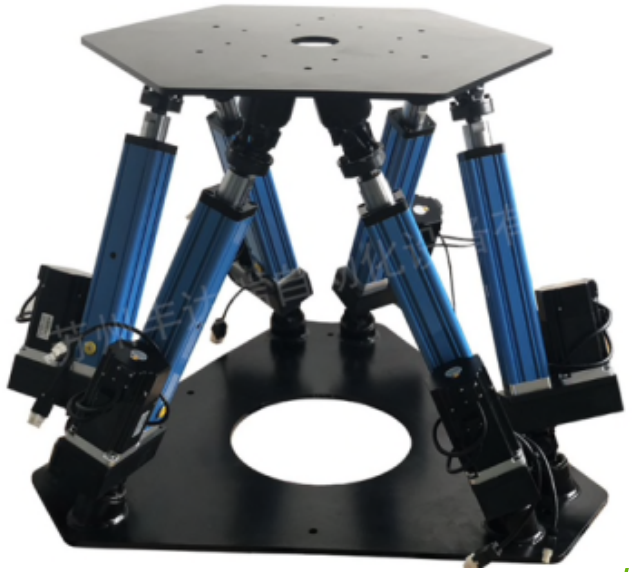
Hardware (OpenSFX inspired)



750 Watt 240V AC Servos
7.5 nm Torque
100mm Travel
245mm/s velocity
Easily move 200kg+ rigs.

Some components:
Base and carrier platfrom
90ST-M02430 220V 750W servo
AASD-15A Driver
Ball screw and ball bearing
Aluminum extrusion profile
Arduino





Software

SimFeedback / SimFeedback-AC-Servo

https://opensfx.com

https://github.com/SimFeedback/SimFeedback-AC-Servo/releases

P-ONE, 2020

SNL / LOCAL COMMUNITY ENGAGEMENT

SERP

SNL/Kirtland Sim-Racing Club

Sim-racing is the future of motorsports. It represents a safe, fun and environmentally friendly way of pursuing the thrill of speed and the excitement of competition. Today, with the advent of fast computer hardware, virtual-reality (VR) and advanced electronics to implement motion- and force-feedback, sim-racing reached an unprecedented degree of realism and immersion. At Sandia Labs, we promote sim-racing as a platform to mingle, develop, inspire and race for fun. In our group we have a prototype ready to race and are developing new ones. Sign up to join our group, try them out and find your space in this exciting tech-community.

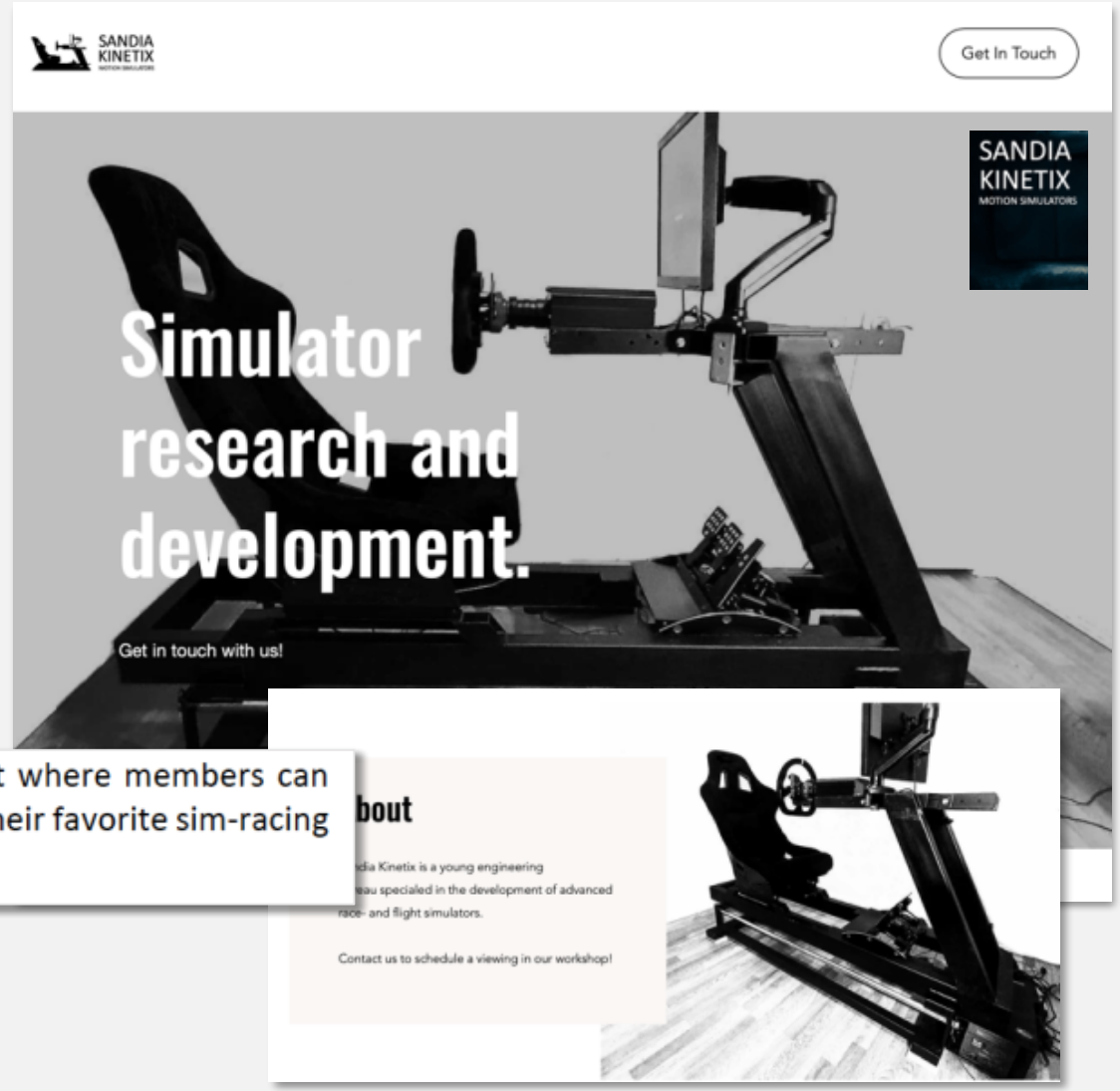
1. Community Objective

Our objective is to create a friendly and supportive environment that inspires friendship, collaboration, creativity and technical application. Our activities welcome all participants.

- Visitors and new members receive a walk-through and learn about software and hardware components, simulation software and basics of actual car racing. They can use our community simulators.
- Existing members engage in areas listed as follows.
  - Cockpit design and development
  - Electronics design and development (actuators, direct-drive systems)
  - Simulator software (physics engines) and virtual-reality systems
  - Sim racing

On subject level, the community objective is to provide an environment where members can work on their racing simulators and periodically practice and compete in their favorite sim-racing software against other members and in national competitions.

The community is open to everyone eligible. There are no sign-up or membership fees. We expect to be able to fund community simulators and operations with a contribution from SNL.



CALL FOR ACTION

- Opportunity for experimentation and follow-up R&D work
- Attract more builders at SNL and create tech community
- Let's have a tech community club house (warehouse, garage)
- Contribute to NM community as an effort to educate and take racing off the street

- **Special thanks to early supporters: Tim Macy, Brad Carvey, Matt Gallegos, Paul Cummings, Karen Susztar (SERP), Michael Wolf, Lanse Freeman, Andrew Hisey and Gavin Leach.**

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